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(54) Water based jet inks

(57) The inks are characterized by the absence of an electrolyte and comprise at least one nigrosine dye and a poly (vinylpyrrolidone) resin. An organic solvent, e.g. an aliphatic alcohol, may be included. The ink can be used in a process for information recording comprising directing a jet of the ink onto a recording medium while modulating the density of the applied jet by an electric field in accordance with the information to be recorded.

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Certain of the chemical formulæ appearing in the printed specification were submitted in formal form after the date of filing.

SPECIFICATION

Water based jet ink

The invention relates jet ink and particularly an aqueous jet printing ink for printing with a jet ink printing system.

The principle underlying jet printing with ink is based on driving ink through a fine nozzle of metal or glass, so that uniform ink particles are ejected from the nozzle tip. These ink particles are electrostatically deflected with a deflecting electrode, arranged in front of the nozzle, so that symbols are printed with a preliminarily determined matrix. In this printing process the ink in the nozzle is divided in fine ink particles and the direction of the ink jet is controlled by deflecting plates or through nozzle movement. This printing process is highly dependent on the properties of the ink. The ink must be capable of forming stable ink particles under pressure and under an electrical field, which have a high deflection sensitivity. Further, the ink must readily emerge from the nozzle. In addition, clogging of the nozzle by drying ink must be prevented. Commercial nozzle jet inks are divided in aqueous and nonaqueous inks. Nonaqueous inks have the disadvantage of low stability ink particles because of low surface tension. As a result, while in flight the ink particles form a fog. In addition, such a nonaqueous ink has a high electrical resistance and a low deflecting sensitivity. At the same time, these ink particles are particularly unstable under a high electrical charge. Consequently, it has been difficult to print clear and distinct symbols with this method.

Presently available commercial jet inks contain an electrolyte. Inks of this invention are free of electrolytes.

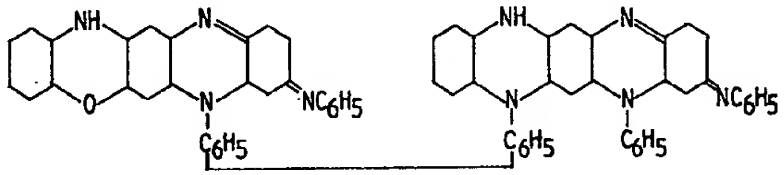
In addition to being free of an electrolyte, inks of this invention contain poly (vinylpyrrolidone) resin in concentration of 1 to 40% dissolved in distilled water.

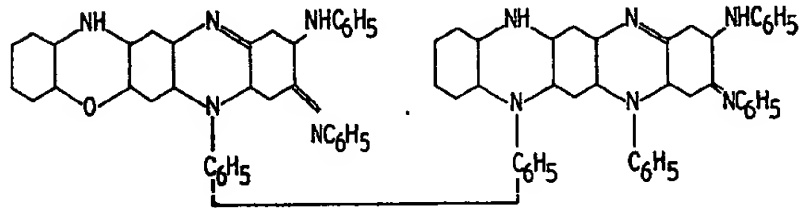
The present invention is a jet ink, which forms stable nozzle jet particles with a high deflecting sensitivity over long paths, which easily emerge from the nozzle and preserve the particle stability in the absence of any electrolyte.

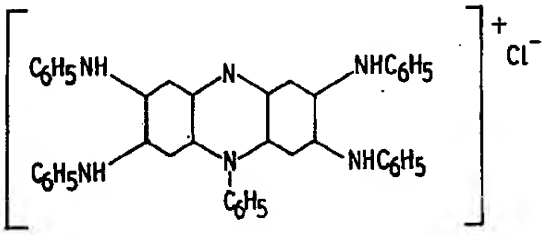
In accordance with the invention this problem is solved through a nozzle jet ink which, in addition to a nigrosine dye component, contains a poly (vinylpyrrolidone) resin, an aliphatic monovalent alcohol and water as a part of a solvent mixture.

The number of formed ink particles is dependent on the properties of the ink in the electrical field of a jet printing system. A nozzle jet which is stable over a long path, high deflecting sensitivity, and easy emergence from the nozzle are important factors, which affect the printing velocity achievable with such an ink. In accordance with the invention, an aqueous ink is created which yields excellent printing results.

The nigrosine dye is not a single clearly identifiable compound but is identified in The Chemistry of Synthetic Dyes and Pigments at page 243 as being a mixture of the following structures :







The compounds shown are the oil soluble derivatives. The nigrosines are rendered water soluble by the addition of sulfonic acid groups [$-SO_3H$] which form the sodium salt [$-SO_3Na$] in basic solutions. Induline 6B is believed to be a side product of the nigrosine fusion.

A further requirement of ink is that it should have sufficient solvent release so that a desired rate of drying is obtained on a given substrate. In order to be effective in a formulation of a jet printing ink for a given substrate, the solvent medium must readily dissolve sufficient amounts of the resin component, the dye and any desirable optional components such as to achieve the desired level of adhesiveness, conductivity and visual impact of the ink composition. Further, since some degree of evaporation of solvent will occur in the ink supply and ink return systems, thereby, increasing the solids concentration in ink and solvent should have sufficient power to prevent precipitation in this situation.

Although evaporation of the solvent from the ink supply and return systems is generally undesirable, it is important that the solvent evaporate at the desired rate from the printed image area in order to leave the printed image smearproof and moistureproof in required time after the printing operation is carried out.

Depending upon type of substrate on which ink is to be printed, it is advantageous to use a solvent which will penetrate the wax or other coating on substrates to enhance adhesion and rub resistance of the ink.

This invention relates to ink jet printing ink which has excellent adhesion on various substrates. More particularly the invention relates to printing ink which is an ink vehicle which comprises, as the essential component, very high weight percent of poly (vinylpyrrolidone) resin dissolved in a blend of solvents to give viscosity in range of 1.5 cps to 25 cps at 25°C and which is compatible with fatty oils; and various oils, resins, resinous varnishes, solvents, etc.,

conventionally used as printing ink materials and further, if necessary, by milling with and dispersing pigments, extenders and/or auxiliary agents in the resulting components.

A drying agent and additional additives, such as surface active agents can be added to the ink. Suitable binding agents (vehicle) are dry oils, such as linseed oil, tung oil, safflower oil, soya oil, dehydrated castor oil; semidrying oils, such as cottonseed oil and beet oil; non-drying oils, such as castor oil and olive oil, aliphatic acids and esters of same, such as oleic acid, linoleic acid, pelargonic acid, caprinic acid, ethyltrideanate and methyl laurate; dicarboxylic acid ester, such as dimethyl phthalate, diethyl phthalate, dibutylphthalate, butylbenzene phthalate, dioctylphthalate, dioctyladipate, dioctylsebacate, dibutylsebacate, monomethyladipate and monoethylpimelate; polyvalent alcohols, such as ethylene glycol, polyethylene glycol, diethylene glycol, propylene glycol, glycerine, dipropylene glycol and esters and ethers of the same, such as diethylene glycol monobutyl ether, dipropylene glycolemonoethyl ester or such.

Liquid resins with a molecular weight under 2000 can also be used, for example, polyester resins, epoxy resins and polybutadiene resins. The essential characteristic feature of the ink in accordance with the invention consists in a content of a mixture of an aliphatic monovalent alcohol and at least one other solvent. Compared to commercial nonaqueous ink, such an ink exhibits a considerably improved printing velocity. As a result of the excellent electrostatic properties deflection is very easy and the ink particles have an increased stability. The ink in accordance with the invention is suited for jet printing devices and electrical field type printers.

The invention is described in the following on the basis of exemplified embodiment.

While there are disclosed below but a limited number of embodiments of the invention herein presented, it is possible to produce still other embodiments without departing from the inventive concepts herein disclosed. Various other modifications will be readily apparent to those skilled in the art.

The following novel compositions are expressed in parts by weight and were prepared by conventional procedure:

Example 1

In the following example a resin and dye are used in developing electrolyte-free jet inks:

Poly (vinylpyrrolidone) resin	20.00
Nigrosine Jet L concentrate	2.50
Distilled water	77.50

Although this invention has been illustrated by reference to specific embodiments, modifications thereof which are clearly within the scope of the invention will be apparent to those skilled in the art.

CLAIMS

1. An aqueous jet printing ink, characterized by the absence of any electrolyte, comprising a mixture of nigrosine dye and poly (vinylpyrrolidone) resin.

2. An ink composition suitable for use in jet printing operations characterized by the absence of any electrolyte consisting essentially of a solution of the following components:

a. poly (vinylpyrrolidone) resin in an amount from 1 to about 40 weight percent,

b. a coloring material in an amount below about 10 weight percent,

c. a solvent mixture containing water and at least one lower aliphatic alcohol or one other solvent in a weight ratio of 1–99:99–1.

3. A process for information recording comprising producing a fine jet of aqueous liquid containing poly (vinylpyrrolidone) and nigrosine dye, directing the jet of liquid onto a recording medium while modulating the density of the applied jet by an electric field in accordance with the information to be recorded, thereby recording said information.

4. An aqueous ink composition suitable for use in jet printing operations consisting essentially of a solution of the following components:

a. poly (vinylpyrrolidone) resin in an amount below about 40 weight percent,

b. a nigrosine dye material in an amount below about 10 weight percent,

c. a solvent or blend of solvents to give desired viscosity.

5. An ink composition of Claim 4 wherein the amount of resin or blend of resins is between about 1 and about 80 weight percent and the ink has a viscosity of between 1.50 cp. and 25.0 cp. at 77°F.

6. An ink composition of Claim 4 wherein the amount of resin or blend of resins is between about 1 and about 50 weight percent and the ink has a viscosity of 1.75cp. and 5.0 cp. at 77°F.

7. An aqueous jet printing ink substantially as hereinbefore described with reference to Example 1.

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